

OVERBURDEN ANALYSES AND  
STRIP-MINE CONDITIONS  
IN THE NORTHWESTERN DISTRICT  
OF THE OHIO COAL-MINING REGION

BY  
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Credit is due George R. Blake, Research Fellow, Department of Agronomy at Ohio State University, for the chemical analyses reported in this paper.



## C O N T E N T S

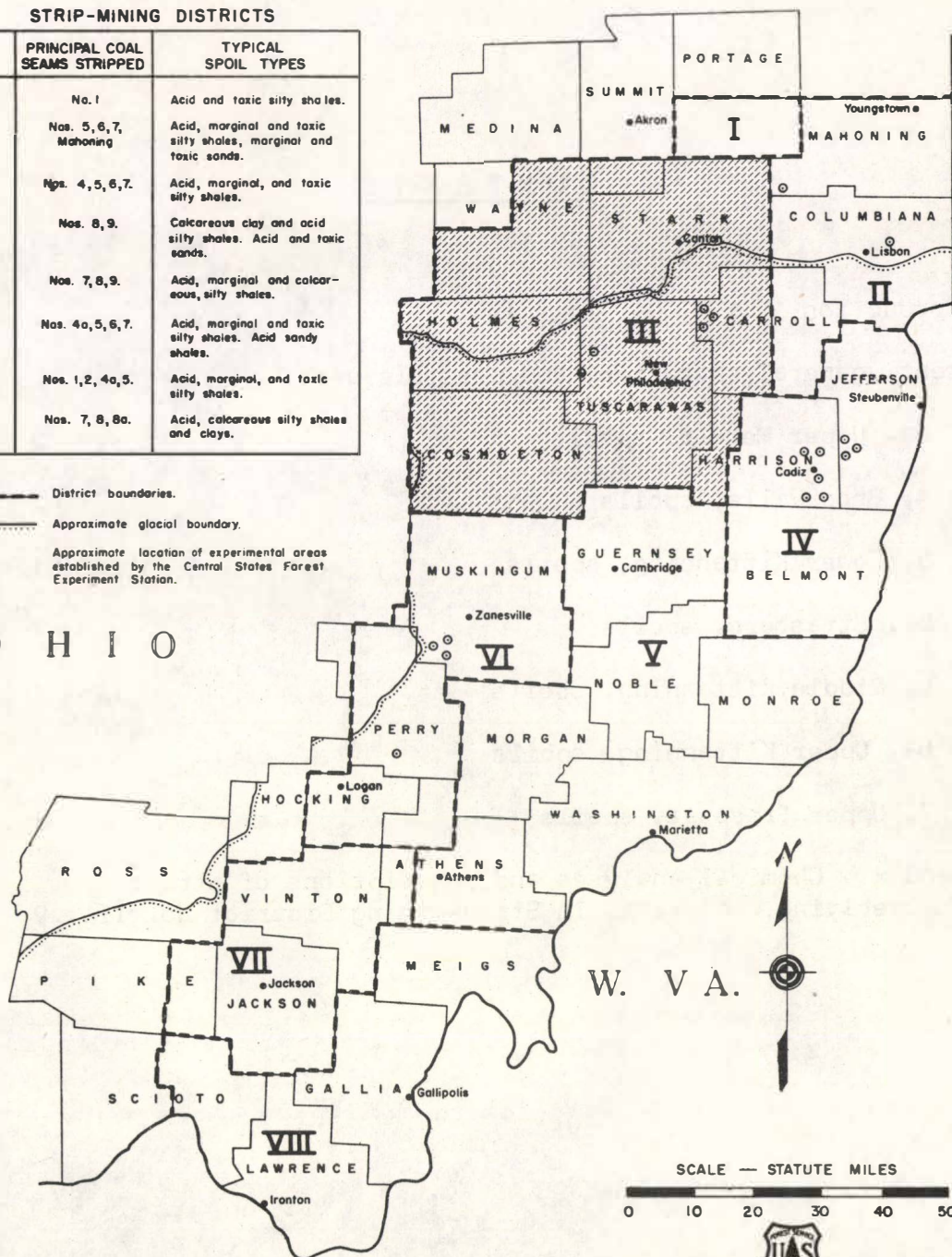
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# STRIP-MINING DISTRICTS

| DIST. NO. | PRINCIPAL COAL SEAMS STRIPPED | TYPICAL SPOIL TYPES  |
|-----------|-------------------------------|--|
| I         | No. 1                         | Acid and toxic silty shales.                                     |
| II        | Nos. 5, 6, 7, Mahoning        | Acid, marginal and toxic silty shales, marginal and toxic sands. |
| III       | Nos. 4, 5, 6, 7.              | Acid, marginal, and toxic silty shales.                          |
| IV        | Nos. 8, 9.                    | Calcareous clay and acid silty shales. Acid and toxic sands.     |
| V         | Nos. 7, 8, 9.                 | Acid, marginal and calcareous, silty shales.                     |
| VI        | Nos. 4a, 5, 6, 7.             | Acid, marginal and toxic silty shales. Acid sandy shales.        |
| VII       | Nos. 1, 2, 4a, 5.             | Acid, marginal, and toxic silty shales.                          |
| VIII      | Nos. 7, 8, 9a.                | Acid, calcareous silty shales and clays.                         |

- District boundaries.
- - - Approximate glacial boundary.
- Approximate location of experimental areas established by the Central States Forest Experiment Station.

O H I O



Frontispiece—The coal-mining region of Ohio. Shaded area on the map shows the location of the strip-mining district described in this report.



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INTRODUCTION

Conditions affecting reclamation measures for strip-mined lands in Ohio vary considerably with the coal seam removed and the locality. Each area requires a distinctive treatment, and the practitioner needs detailed information to help him choose the best possible uses for these lands. A basic classification of spoils for forest planting and a description of the factors to be considered in this classification have already been published.<sup>1/</sup> A publication on general spoil-bank conditions in Ohio, with detailed forest planting recommendations, was also released recently.<sup>2/</sup>

The coal-mining region of Ohio has been subdivided into eight strip-mining districts (frontispiece). Although there is some overlapping of characteristics, spoil conditions in each district are different enough to make convenient units for detailed descriptions of strip-mine reclamation problems in the state. A reconnaissance of lands stripped for coal was made in 1945, 1946, and 1947. Each area was examined to determine its condition for plant growth, a record was made of these conditions, and a map of the area was prepared. The high-walls next to most strippings were carefully examined, and described stratigraphically. Samples of spoil surfaces and of each stratum found in the high-walls were collected for laboratory analyses.

The main purpose of this report is to summarize these reconnaissance data for ready use by practitioners concerned with spoil-bank conditions in Strip-Mining District No. III in Ohio. This district includes the western half of Carroll County and all of the coal-bearing lands in Coshocton, Holmes, Stark, Summit, Tuscarawas, and Wayne Counties. The part of western Harrison County where No. 6 and No. 7 coal seams outcrop is also included in this district. Another purpose of this report is to contribute to the general knowledge of Ohio geology by permanently recording the stratigraphic data.

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<sup>1/</sup> G. A. Limstrom. Extent, character, and forestation possibilities of land stripped for coal in the Central States. Central States Forest Expt. Sta. Tech. Paper No. 109. 1948.

<sup>2/</sup> ----- and R. W. Merz. The rehabilitation of lands stripped for coal in Ohio. Central States Forest Expt. Sta. Tech. Paper No. 113. 1949.

## EXTENT, GENERAL CHARACTER, AND POSSIBLE USES

As many as seven different coal seams have been strip-mined in the district (table 1). Of the 7,745 acres of stripped lands found at the time of the field survey, however, 4,780 acres--more than 61 percent of the total area--resulted from mining No. 5, Lower Kittanning, coal. About 1,900 acres, or 25 percent, resulted from mining No. 6, Middle Kittanning, coal. The spoils are chiefly acid, silty shales, with pH ranges generally from 3.0 to 5.5. Physical conditions are generally good for plant growth; composed largely of shale, silt, and clay, the spoils are of rather loose consistency, are well aerated, and contain enough fine material to hold an adequate moisture supply for good survival and growth of forest plantations. The "rounding-off" of ridge tops is relatively rapid and the somewhat flattened troughs between ridges are potentially good sites for growing many hardwoods.

Because the spoils in the district are highly acid, the use of most of the strip-mined lands for pastures or cultivated crops is not practical; tree planting to improve site conditions and to grow forest products should be the primary reclamation measure. The area stripped for No. 4 coal in Wayne County, where the spoils are composed largely of calcareous glacial till, is one of the few exceptions.

### NO. 3a, UPPER MERCER, SPOILS

Although not positively identified, one stripping in Stark County was made for what is believed to be No. 3a, Upper Mercer, coal. The stripped area is located on a hillside in Section 14 of Sugar Creek township, about 40 feet below the No. 4, Brookville, seam which has also been mined by stripping methods. Directly over the coal is a 2-foot bed of greasy, thin-bedded, calcareous, fossiliferous shale (p. 13, Appendix); above this stratum is a 1-foot section of red, ferruginous, thick-bedded, calcareous shale. Over the thick-bedded shale is a 1-foot layer of gray, acidic, silty shale, capped by 4 feet of ferruginous, massive sandstone. Above the sandstone is 8 feet of a mixture of gray, thin-bedded silty shale, gray to yellow mottled clay, and ironstones. The spoil surfaces are classified as an acid, stony loam, with pH ranging from 4.0 to 5.5. Although the spoils were 8 years old at the time they were examined, they contained only about 35 percent soil; larger particles were composed chiefly of sandstone and shale.

### NO. 4, BROOKVILLE, SPOILS

Four strippings for No. 4, Brookville, coal were found in the district--two in Stark County, one in Wayne County, and one in Franklin Township of Tuscarawas County. The No. 4 banks in Stark



Table 1.--Area of strip-mined lands in Strip-Mining District No.  
 III, Ohio, by coal seam, spoil texture, spoil acidity,  
 and county, 1946

| Coal<br>seam <sup>1/</sup> | Character of<br>spoils |          | County            |            |         |        |             |        |
|----------------------------|------------------------|----------|-------------------|------------|---------|--------|-------------|--------|
|                            | Texture:               | Acidity: | Carroll:          | Coshocton: | Holmes: | Stark: | Tuscarawas: | Wayne: |
| - - - - - Acres - - - - -  |                        |          |                   |            |         |        |             |        |
| 3a                         | Loam                   | Acid     | -                 | -          | -       | 8      | -           | -      |
| 4                          | Loam                   | Acid     | -                 | -          | -       | 21     | 1           | -      |
|                            |                        | Mixed    | -                 | -          | -       | 7      | -           | -      |
|                            |                        | Calc.    | -                 | -          | -       | -      | -           | 45     |
|                            |                        | Marg.    | -                 | -          | -       | 45     | -           | -      |
| 5                          | Sand                   | Acid     | 22                | -          | -       | -      | -           | -      |
|                            |                        | Toxic    | -                 | -          | -       | 151    | -           | -      |
|                            |                        | Marg.    | -                 | -          | -       | 94     | 182         | -      |
|                            | Loam                   | Acid     | 394               | -          | 152     | 548    | 2894        | -      |
|                            |                        | Toxic    | -                 | -          | -       | 243    | -           | -      |
|                            |                        | Marg.    | -                 | -          | -       | 17     | -           | -      |
|                            |                        | Acid     | -                 | -          | -       | -      | -           | 15     |
|                            |                        | Calc.    | -                 | -          | -       | 38     | -           | -      |
|                            |                        | Acid     | 30                | 19         | -       | 79     | -           | -      |
|                            |                        | Mixed    | -                 | -          | -       | 26     | -           | -      |
|                            | Clay                   | Toxic    | -                 | -          | -       | 16     | -           | -      |
|                            |                        | Marg.    | -                 | 133        | -       | -      | 38          | -      |
|                            |                        | Acid     | 123               | 290        | 91      | 447    | 187         | -      |
| <sup>2/</sup> 5 & 6        | Clay                   | Acid     | -                 | 56         | -       | -      | -           | -      |
|                            | Loam                   | Marg.    | -                 | -          | -       | 130    | -           | -      |
|                            |                        | Acid     | -                 | -          | -       | 272    | 594         | -      |
|                            |                        | Toxic    | -                 | -          | -       | 13     | -           | -      |
|                            | Clay                   | Acid     | -                 | -          | -       | 106    | -           | -      |
| 6a                         | Loam                   | Acid     | -                 | -          | -       | -      | 13          | -      |
| 7                          | Sand                   | Acid     | -                 | -          | -       | 39     | -           | -      |
|                            | Loam                   | Acid     | 86                | -          | -       | 9      | 60          | -      |
|                            | Clay                   | Mixed    | -                 | -          | -       | 11     | -           | -      |
| Totals                     |                        |          | <sup>3/</sup> 655 | 498        | 243     | 2320   | 3969        |        |

- <sup>1/</sup> No distinct spoil banks resulting only from the stripping of No. 5a, Strasburg, coal were found during the survey; strata overturned in mining this coal are mixed into banks resulting mainly from mining No. 5 coal.
- <sup>2/</sup> Stripping of both seams on same area.
- <sup>3/</sup> For the western half of Carroll County.

County are located in Section 8, Pike Township, and Section 14 of Sugar Creek Township; in Wayne County the one operation observed is located in Section 18 of Paint Township, about 3 miles west of Mt. Eaton. In Stark and Tuscarawas Counties the 1- to 3-foot layer of limestone directly over the No. 4 coal seam serves as a good identifying feature (pp. 11 and 12). In Wayne County this limestone was not found in the one high-wall examined; instead, there was a thick layer of calcareous shale (p. 12).

The No. 4 spoils in Stark and Tuscarawas Counties are acid, stony and shaly loams, with a few scattered calcareous surfaces. In Wayne County the No. 4 spoils are perhaps the best for plant growth in the state. The thick mantle of calcareous glacial till and the calcareous shale located beneath it in the high-wall are mixed in the stripping operation to form a fertile, well-aerated, stony, sandy loam.

#### NO. 5, LOWER KITTANNING, SPOILS

Strip-mining for No. 5, Lower Kittanning, coal in the district is rather extensive; most of these spoils are located in northern Tuscarawas and southern Stark Counties. From a study of 21 high-walls, about 64 percent of the overburden is carbonaceous, silty and clayey shales, in which are imbedded several iron compounds, including red kidney ores, limonitic geodes, and pyrites. The pH of the shales varies from 3.0 to 7.0. About 14 percent of the overburden, on the average, is composed of sandstone or sandy shale; if the stripping is shallow, however, sandy material is absent. About 22 percent of the overburden is made up of soil, glacial till, clay, and coal seams located above the No. 5 coal, such as the No. 5a, Strasburg, and No. 6, Middle Kittanning, coals. The color of the silty and clayey shales varies from purple to gray and black; the sandy shales are usually tan or yellowish-brown. Most of the strata in the overburden are high in available phosphorus; some are also high in available potash (pp. 14 to 27).

Most of the spoils resulting from strip-mining for No. 5 coal in the district are silty loams and contain large amounts of shale (table 2). A few sandy spoils occur in Carroll and Stark Counties, and in Stark and Wayne Counties there are also a few clay spoils. From a distance they usually appear black or purplish in color with a few scattered patches of yellow. The silty and clay shales account for the dark colors, and the sandy shales and sandstone account for most of the yellow coloring.

The high proportion of shale results in spoils of rather loose consistency, good aeration, and high infiltration rates. Because of their loose consistency, there is much siltation in the bottoms between bank ridges; these make excellent sites for growing such species as white ash, black walnut, and yellow poplar.



Table 2.--Mechanical analyses of samples of banks  
located in the Northwestern District

NO. 5 BANK, SECTION 13, WAYNE TOWNSHIP, TUSCARAWAS COUNTY  
 3 YEARS AFTER STRIPPING

| Sample No.     | Stone | "Soil" <sup>1/</sup> | Composition of "soil" fraction <sup>2/</sup> |      |      |
|----------------|-------|----------------------|--|------|------|
|                |       |                      | Sand   | Silt | Clay |
| <u>Percent</u> |       |                      |  |      |      |
| 1              | 47.5  | 52.5                 | 2.6  | 51.4 | 46.0 |
| 2              | 38.7  | 61.3                 | 12.8   | 34.4 | 52.8 |
| 3              | 66.2  | 33.8                 | 27.6   | 34.6 | 37.8 |
| 4              | 67.2  | 32.8                 | 13.6   | 38.4 | 48.0 |

NO. 6 BANK, SECTION 33, ROSE TOWNSHIP, CARROLL COUNTY  
 2 YEARS AFTER STRIPPING

|   |      |      |      |      |      |
|---|------|------|------|------|------|
| 1 | 51.5 | 48.5 | 16.6 | 45.4 | 38.0 |
| 2 | 56.3 | 43.7 | 9.6  | 48.4 | 42.0 |

NO. 6 BANK, SECTION 24, FRANKLIN TOWNSHIP, TUSCARAWAS COUNTY  
 4 YEARS AFTER STRIPPING

|   |      |      |      |      |      |
|---|------|------|------|------|------|
| 1 | 61.2 | 38.8 | 25.2 | 34.6 | 40.2 |
| 2 | 81.9 | 18.1 | 40.8 | 29.2 | 30.0 |
| 3 | 57.3 | 42.7 | 20.0 | 45.2 | 34.8 |

<sup>1/</sup> Particles 2mm. and smaller in diameter.

<sup>2/</sup> Analyses by the Bouyoucos hydrometer method.

The acidity of No. 5 spoils in the district is generally in the pH range of 3.5 to 5.0; toxic patches of various sizes occur on most of the banks. Most of the toxic spoils are located in the East Canton area of Stark County where No. 5 coal is mined in conjunction with the stripping for clay. The casual observer often concludes that all of the dark-colored areas on No. 5 spoils are toxic; samples taken from these areas, however, indicate that the pH ranges from 2.8 to 7.0 and that a high proportion is nontoxic. A 20-acre experimental planting was made on such an area in Wayne Township, Tuscarawas County, using a wide variety of species rigidly spaced over the entire area. At the end of 2 years the mortality from toxicity was less than 30 percent (fig. 1). In other words, acidity conditions permitted planting on 70 percent of the area.

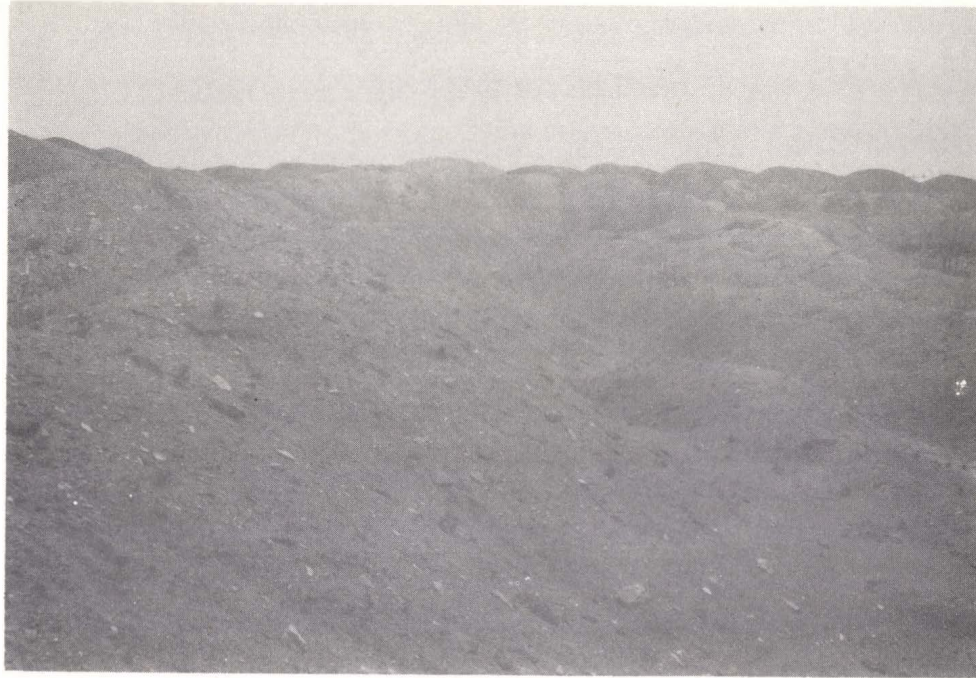


Figure 1.--Typical spoil banks resulting from stripping for No. 5, Lower Kittanning, coal. The top photo was taken in spring 1946 just after a variety of species were planted. Lower photo shows the same area in August 1950. Note the varying growth of species tested. In the left and right background is black locust; in right center is yellow poplar; in the foreground is white pine. All were planted in the spring of 1946 in Tuscarawas County.



#### NO. 5a, STRASBURG, SPOILS

A small amount of No. 5a coal is recovered by stripping in Tuscarawas County. This seam lies just a short distance above the No. 5 coal in a few localities, and is stripped only in conjunction with it. The spoil is mixed with that removed in the stripping for No. 5 coal. No distinct No. 5a spoils were found in the district.

#### NO. 6, MIDDLE KITTANNING, SPOILS

Stripping for No. 6, Middle Kittanning, coal was noted in Carroll, Coshocton, Holmes, Stark, and Tuscarawas Counties. The operations for this coal are, however, not as extensive as for No. 5 coal in the district.

The overburden of the No. 6 seam is similar to that of the No. 5, in that both are composed chiefly of silty and clay shales, sandstone, and sandy shales. However, the No. 6 overburden generally includes more sandy material; the average composition of the No. 6 overburden, based on 12 high-wall analyses, was 10 percent soil and clay, 33 percent sandy material, and 57 percent silty and clayey shales. Most of the shales, high in available phosphorus but low in potash, are black or gray in color, and are carbonaceous. They are mixed with many yellow and reddish concretions, but with few or no red kidney ores (pp. 28 to 34). The strata over No. 6 coal are generally not as highly acid as those over the No. 5 seam.

The texture of No. 6 spoils varies considerably from one area to another, depending upon the relative amounts of sandy material placed on the bank surfaces in each operation (table 2). A few are predominantly sandy or clayey; more than 80 percent, however, are silty-shale loams. Spoil surfaces are grayish to purplish, grading into yellow or tan as the proportion of sandy material becomes greater.

Although a few toxic banks occur on No. 6 strippings, acidity conditions are generally more favorable than on No. 5 spoils. The pH ranges from 4.0 to 6.9, but on a high proportion of the areas the range is between 5.0 to 6.9. Most of the toxicity comes from pyritic materials in the carbonaceous shales lying directly over the coal seam. The greatest concentration of toxic spoils resulting from stripping this coal in the district is in Coshocton County.

#### NO. 6a, UPPER KITTANNING, SPOILS

Only one strip-mined area resulting from the stripping of what was believed to be the No. 6a coal was found in the district. This area consisted of 13 acres in Salem Township, Tuscarawas

County. The spoils were classified as an acid, silty shale, composed roughly of 35 percent soil, 55 percent shale, and 10 percent limestone. In Ohio this coal is rarely thick enough to be minable; very little future stripping for this coal is likely.

#### NO. 7, UPPER FREEPORT, SPOILS

Some stripping for this coal was found in Carroll, Stark, and Tuscarawas Counties. This overburden also is composed mainly of silty shales and sandy material. One identifying characteristic, however, is the hard, slaty, carbonaceous, blue-black shale lying directly over the coal (pp. 35 and 36). The spoils vary in composition from sands to clays, but are generally silty shales. Few toxic patches occur, and the pH range is usually between 4.5 and 7.0.



# APPENDIX

## Chemical analyses and descriptions of strata overlying coal seams in Strip-mining District No. III

| <u>Coal<br/>Seam<br/>No.</u> | <u>County</u> | <u>Township</u> | <u>Section</u> | <u>Page<br/>No.</u> |
|------------------------------|---------------|-----------------|----------------|---------------------|
| 3a                           | Stark         | Sugar Creek     | 14             | 10                  |
| 4                            | Stark         | Pike            | 8              | 11                  |
| 4                            | Wayne         | Paint           | 18             | 12                  |
| 4                            | Stark         | Sugar Creek     | 14             | 13                  |
| 5                            | Carroll       | Rose            | 30             | 14                  |
| 5                            | Carroll       | Rose            | 31             | 14                  |
| 5                            | Carroll       | Rose            | 32             | 14                  |
| 5                            | Holmes        | Walnut Creek    | -              | 15                  |
| 5                            | Tuscarawas    | Dover           | 2              | 16                  |
| 5                            | Tuscarawas    | Dover           | 12             | 16                  |
| 5                            | Tuscarawas    | Dover           | 20             | 17                  |
| 5                            | Tuscarawas    | Sandy           | 2              | 17                  |
| 5                            | Tuscarawas    | Wayne           | 13             | 18                  |
| 5                            | Stark         | Bethlehem       | 30             | 19                  |
| 5                            | Stark         | Canton          | 22             | 19                  |
| 5                            | Stark         | Canton          | 23             | 20                  |
| 5                            | Stark         | Canton          | 26             | 21                  |
| 5                            | Stark         | Lexington       | 29             | 21                  |
| 5                            | Stark         | Osnaburg        | 19             | 21                  |
| 5                            | Stark         | Osnaburg        | 20             | 22                  |
| 5                            | Stark         | Pike            | 1              | 23                  |
| 5                            | Stark         | Pike            | 7              | 24                  |
| 5                            | Stark         | Sandy           | 4              | 25                  |
| 5                            | Stark         | Sandy           | 17             | 26                  |
| 5                            | Stark         | Sandy           | 5              | 27                  |
| 5                            | Stark         | Tuscarawas      | 19             | 27                  |
| 6                            | Carroll       | Rose            | 30             | 28                  |
| 6                            | Carroll       | Rose            | 33             | 28                  |
| 6                            | Coshocton     | Adams           | -              | 29                  |
| 6                            | Coshocton     | Bedford         | 7              | 29                  |
| 6                            | Coshocton     | Jackson         | -              | 29                  |
| 6                            | Stark         | Canton          | 31             | 30                  |
| 6                            | Stark         | Canton          | 36             | 30                  |
| 6                            | Stark         | Osnaburg        | 7              | 31                  |
| 6                            | Stark         | Osnaburg        | 28             | 31                  |
| 6                            | Stark         | Osnaburg        | 30             | 32                  |
| 6                            | Stark         | Paris           | 8              | 32                  |
| 6                            | Stark         | Pike            | 28             | 33                  |
| 6                            | Tuscarawas    | Sandy           | 2              | 34                  |
| 6                            | Tuscarawas    | Sandy           | 11             | 34                  |
| 7                            | Stark         | Osnaburg        | 10             | 35                  |
| 7                            | Stark         | Paris           | 1              | 36                  |

NO. 3a, UPPER MERCER, COAL

STARK COUNTY

Section 14, Sugar Creek Township

| Description of strata<br>(Top to bottom)  | Thickness     | Acidity      | Available <sup>1/</sup> | Available <sup>1/</sup> |
|---|---------------|--------------|-------------------------|-------------------------|
|   | of<br>strata  | of<br>strata | phosphorus              | potassium               |
|   | <u>Feet</u>   | <u>pH</u>    |                         |                         |
| Soil--gray loam; acidic   | $\frac{1}{2}$ | 4.9          | Low <sup>2/</sup>       | Low                     |
| Subsoil--a brown silty clay; acidic   | 2             | 5.2          | Low                     | Low                     |
| Alternate 1-foot strata, first of gray, thin-bedded, silty shale; then gray to yellow mottled clay, all acidic; mixed with both are large red boulders that look like iron nodules but are calcareous | 8             | 5.6          | Medium                  | Low                     |
| Sandstone--massive and fragmental, gray; acidic, ferruginous  | 4             | 5.0          | Medium                  | Low                     |
| Shale--gray, silty, acidic upper foot; then red, ferruginous, thick-bedded, calcareous shale for another foot; then a greasy, thin-bedded calcareous, fossiliferous shale                             | 4             | 6.6          | Medium                  | Low                     |
| Coal--No. 3a  |               |              |                         |                         |

<sup>1/</sup> The techniques used in the chemical analyses are described in these publications:

R. H. Bray. Photometer method for determining available potassium in soils. Dept. of Agron., Agr. Expt. Sta., Ill. Univ. Col. of Agr. Mimeo. Cir. No. AG 1275. Sept. 1945.

Charles Y. Arnold and Touby Kurtz. Photometer method for determining available phosphorus in soils. Depts. of Agron. and Hort., Agr. Expt. Sta., Ill. Univ. Col. of Agr. Mimeo. Cir. No. AG 1306. June 1946.

<sup>2/</sup> For soils the readings "High," "Medium," and "Low" indicate the following quantities per acre:

|            | <u>Low</u>        | <u>Medium</u> | <u>High</u>   |
|------------|-------------------|---------------|---------------|
|            | (Pounds per acre) |               |               |
| Phosphorus | Less than 53      | 54-75         | More than 75  |
| Potassium  | Less than 100     | 100-150       | More than 150 |



NO. 4, BROOKVILLE, COAL

STARK COUNTY

Section 8, Pike Township

| Description of strata<br>(Top to bottom)  | Thickness            | Acidity              | Available      | Available     |
|---|----------------------|----------------------|----------------|---------------|
|   | : of :<br>: strata : | : of :<br>: strata : | : phosphorus : | : potassium : |
|   | <u>Feet</u>          | <u>pH</u>            |                |               |
| Soil--gray silty clay loam  | $\frac{1}{2}$        | 4.3                  | Low            | Low           |
| Shale--gray, thin-bedded,<br>silty to fine sandy; acidic;<br>mixed with some orange iron<br>concretions   | 10                   | 4.6                  | Medium         | Low           |
| Sandstone--gray; massive;<br>acidic   | 4                    | 5.4                  | Low            | Low           |
| Shale--thick-bedded, sandy to<br>silty; ferruginous; acidic   | -                    | 5.0                  | Medium         | Low           |
| Shale--gray, thin-bedded, silty;<br>acidic; fossiliferous, mixed<br>with many small calcareous<br>nodules | 6                    | 5.6                  | Medium         | Low           |
| Shale--clayey, carbonaceous,<br>soft, rotten; <u>highly</u> acidic  | 1                    | 2.8                  | Low            | Medium        |
| Limestone--gray; massive  | 3                    | 6.0                  | Low            | Low           |
| Coal--No. 4   | -                    | -                    | -              | -             |

NO. 4, BROOKVILLE, COAL

WAYNE COUNTY

Section 18, Paint Township

| Description of strata<br>(Top to bottom)   | Thickness            | Acidity              | Available      | Available     |
|--|----------------------|----------------------|----------------|---------------|
|  | : of :<br>: strata : | : of :<br>: strata : | : phosphorus : | : potassium : |
|  | <u>Feet</u>          | <u>pH</u>            |                |               |
| Soil--gray silty clay loam;<br>acidic; pebbly  | $\frac{1}{2}$        | 5.5                  | High           | Low           |
| Subsoil--glacial silty clay;<br>acidic, mixed with glacial<br>rocks (granite)                            | 1                    | 5.3                  | Low            | Low           |
| Glacial till--mixture of sand,<br>clay, sandstone, granite, other<br>igneous rocks; calcareous           | 24                   | 7.5                  | High           | Low           |
| Shale--gray, very hard, thin-<br>bedded; calcareous, but mixed<br>with highly acidic ferruginous<br>ores | 12                   | 7.2                  | Low            | Low           |
| Coal--No. 4  | -                    | -                    | -              | -             |



NO. 4, BROCKVILLE, COAL

STARK COUNTY

Section 14, Sugar Creek Township

| Description of strata<br>(Top to bottom)   | Thickness<br>(Feet) |
|--|---------------------|
| Soil--gray sandy loam; acidic  | $\frac{1}{2}$       |
| Sandy clay--mixed with sandy shale and fragmental sandstone  | 4                   |
| Shale--gray, hard, silty, with concretions; fossiliferous, thin-bedded; acidic                       | 14                  |
| Limestone--massive, consisting of huge well-rounded boulders, considerably weathered by water action | 3                   |
| In spots this limestone is replaced by a ferruginous, thin-bedded, acidic, silty shale               | -                   |
| Coal--No. 4  | -                   |

Note: Some evidence of glaciation noted--one large granite boulder.

NO. 5, LOWER KITTANNING, COAL

CARROLL COUNTY

Section 30, Rose Township

| Description of strata<br>(Top to bottom)  | Thickness<br>(Feet) |
|---|---------------------|
| Soil and glacial till--sandy, pebbly  | 4                   |
| Sandstone--gray; upper 1/3 fragmental, lower 2/3 massive                                  | 20                  |
| Shale--gray to blue, hard, fossiliferous; calcareous; silty, thin-bedded and thick-bedded | 8                   |
| Shale--Hamden, silty, fossiliferous; calcareous, with nodular limestone                   | 2                   |
| Coal--No. 5   | -                   |

Section 31, Rose Township

|  |           |
|--|-----------|
| Soil--brown sandy loam   | 1         |
| Subsoil--broken down sandstone and sandy shale with large amounts of sand; mottled, buff | 6         |
| Shale--silty, black, carbonaceous, thin-bedded; bands of kidney ore                      | 12+       |
| Coal--No. 5  | 3 approx. |

Section 32, Rose Township

|  |       |
|--|-------|
| Soil--light tan clay loam  | 1     |
| Subsoil--clay, cream grading to pink and gray                                  | 2 - 4 |
| Coal--No. 6, thin, shaly   | 1 - 2 |
| Shale--dark brown to gray-tan  | 4 - 6 |
| Shale--dark gray to black, silty; carbonaceous; fissile to massive near bottom | 6 - 8 |
| Coal--No. 5  | 2 - 3 |

NO. 5, LOWER KITTANNING, COAL

HOLMES COUNTY

Walnut Creek Township

| Description of strata<br>(Top to bottom)   | Thickness<br>(Feet) |
|--|---------------------|
| Soil--brown sandy loam   | 1                   |
| Sand--sandy shale and sandstone, light tan to<br>creamy gray; massive in places but usually in<br>thin horizontal beds | 12 - 18             |
| Flint clay--often lenticular, nodular, slickensided,<br>blue-gray; gritty with thin layer of tan clay at<br>bottom     | 0 - 8               |
| Shale--soft, fissile, black, silty; carbonaceous   | 1 - 3               |
| Coal--No. 5  | 2 - 3               |



NO. 5, LOWER KITTANNING, COAL

TUSCARAWAS COUNTY

Section 2, Dover Township

| Description of strata<br>(Top to bottom)   | Thickness<br>(Feet) |
|--|---------------------|
| Soil--tan sandy loam   | 1                   |
| Subsoil--clay, mottled, hard   | 5                   |
| Coal--No. 5a   | 1 - 1½              |
| Shale--silty, hard, thin-bedded, multicolored--<br>mostly shades of tan with reddish tinge | 6                   |
| Shale--black to dark gray with layers of limonitic<br>rock                                 | 12                  |
| Coal--No. 5  | -                   |

Section 12, Dover Township

|   |        |
|---|--------|
| Soil--dark brown sandy loam   | ½      |
| Subsoil--lighter brown sandy loam   | 1½     |
| Sandy shale and/or sand grading to silty sandy shale<br>near bottom--no definite strata   | 3      |
| Coal--No. 5a  | 2 - 2½ |
| Underclay grading to shale, gray to blackish; bands<br>of red to rusty ore, sometimes faintly effervescent;<br>clay to silt, soft | 4 - 12 |
| Coal--No. 5   | 2½ - 3 |

NO. 5, LOWER KITTANNING, COAL

TUSCARAWAS COUNTY

Section 20, Dover Township

| Description of strata<br>(Top to bottom)  | Thickness<br>(Feet) |
|---|---------------------|
| Soil--brown sandy loam  | 1                   |
| Mixed sand, sandy shale, and sandstone; no true subsoil; grades into a thin-bedded sandstone with few massive pieces; tan | 8                   |
| Shale--nodular to thin-bedded clay shale; ferrous colorations, mostly light gray  | 3                   |
| Shale--fissile, black; bony in places, with many bands of limonitic rock  | 12                  |
| Coal--No. 5   | -                   |

Section 2, Sandy Township

|  |                   |
|--|-------------------|
| Soil--dark brown sandy loam  | $\frac{1}{2}$ - 1 |
| Subsoil--hard red-brown sandy loam                                   | 1 - 2             |
| Shale--sandy, thin-bedded, light tan                                 | 4 - 10            |
| Shale--silty, dark rust grading to black                             | 2 - 4             |
| Shale--silty, black, soft grading to very hard and bony; thin-bedded | 6 - 8             |
| Coal--No. 5  | -                 |

NO. 5, LOWER KITTANNING, COAL

TUSCARAWAS COUNTY

Section 13, Wayne Township

| Description of strata<br>(Top to bottom)   | : Thickness :        | Acidity :            | Available :    | Available   |
|--|----------------------|----------------------|----------------|-------------|
|  | : of :<br>: strata : | : of :<br>: strata : | : phosphorus : | : potassium |
|  | <u>Feet</u>          | <u>pH</u>            |                |             |
| Soil--brown loam; acidic   | $\frac{1}{2}$        | 6.6                  | High           | Low         |
| Subsoil--reddish-yellow sandy<br>loam mixed with sandstone<br>fragments  | 5                    | 5.8                  | Low            | Low         |
| Sandstone--fragmental, mixed<br>with reddish-yellow sand;<br>slightly ferruginous  | 11                   | 4.9                  | Low            | Low         |
| Shale--grayish-black, mottled<br>red; carbonaceous; thin-bedded  | 26                   | 6.6                  | High           | Medium      |
| Shale--grayish-black with red<br>mottling; carbonaceous; mixed<br>with red kidney ores, concre-<br>tions and some marcasite;<br>acidic | 11                   | 7.0                  | High           | High        |
| Coal--No. 5  | -                    | -                    | -              | -           |



NO. 5, LOWER KITTANNING, COAL

STARK COUNTY

Section 30, Bethlehem Township

| Description of strata<br>(Top to bottom)  | Thickness<br>(Feet) |
|---|---------------------|
| Soil--gray silt loam; acidic  | $\frac{1}{2}$       |
| Subsoil--sandy clay, brown mixed with fragmental sandstone; acidic  | 3                   |
| Shale--gray, silty to sandy, mixed with sand and clay; acidic   | 8                   |
| Shale--blue-gray, fossiliferous, soapy, soft, with some concretions; acidic                               | 16                  |
| Shale--gray-black, silty, <u>slaty</u> ; thin-bedded; fossiliferous, with nodular limestone; carbonaceous | 10                  |
| Coal--No. 5   | -                   |

Section 22, Canton Township

|  |               |
|--|---------------|
| Soil--dark gray-black silt loam; acidic  | $\frac{1}{2}$ |
| Subsoil--glacial till, brown sandy clay, mixed with fragments of sandstone; acidic                           | 1             |
| Clay--plastic, gray, brown mottling; acidic  | -             |
| Shale--gray, silty, carbonaceous; mixed with red iron concretions (not red kidney ores)                      | 10            |
| Coal--soot streak, probably 5a, shaly  | 4             |
| Shale--gray to black, soft, clayey, fossiliferous; carbonaceous, with iron concretions and limestone nodules | 6             |
| Coal--No. 5  | -             |

NO. 5, LOWER KITTANNING, COAL

STARK COUNTY

Section 23, Canton Township

| Description of strata<br>(Top to bottom)   | Thickness                     | Acidity                       | Available      | Available     |
|--|-------------------------------|-------------------------------|----------------|---------------|
|  | : of :<br>: strata : strata : | : of :<br>: strata : strata : | : phosphorus : | : potassium : |
|  | <u>Feet</u>                   | <u>pH</u>                     |                |               |
| Soil--gray-brown sandy loam;<br>acidic   | 1                             | 4.4                           | High           | Low           |
| Sandstone--gray; massive;<br>acidic  | 2                             | 4.4                           | Medium         | Low           |
| Clay--yellowish-orange; ferru-<br>ginous, plastic; acidic  | 5                             | 3.9                           | Medium         | Low           |
| Coal--No. 5a, sooty  | 1                             | 3.4                           | High           | Low           |
| Shale--gray-black, soft, thin-<br>bedded; acidic; carbonaceous;<br>mixed with some nodular lime-<br>stone and ferruginous concre-<br>tions | 8                             | 3.2                           | Medium         | Medium        |
| Shale--clayey, soft, carbona-<br>ceous; <u>highly acidic</u> ; mixed<br>with an 8-inch stratum of hard,<br>ferruginous rock                | 2                             | 3.2                           | Low            | High          |
| Coal--No. 5  | -                             | -                             | -              | -             |

NO. 5, LOWER KITTANNING, COAL

STARK COUNTY

Section 26, Canton Township

| Description of strata<br>(Top to bottom)   | Thickness<br>(Feet) |
|--|---------------------|
| Soil--dark gray  | $\frac{1}{2}$       |
| Clay--plastic, gray-yellow   | 6                   |
| Shale--thin-bedded, gray-black; carbonaceous   | 8                   |
| Coal--No. 5a, poor quality, shaly  | 1                   |
| Shale--gray-black, carbonaceous; thin-bedded, with<br>calcareous and ferruginous concretions | 6                   |
| Coal--No. 5  | -                   |

Section 29, Lexington Township

|   |               |
|---|---------------|
| Soil--dark gray silty clay loam; acidic                         | $\frac{1}{2}$ |
| Glacial till--mostly gray-brown clay; acidic                    | 3             |
| Shale--thin-bedded, soft, ferruginous; acidic; gray<br>to black | 12            |
| Coal--No. 5   | -             |

Section 19, Osnaburg Township

|  |                |
|--|----------------|
| Soil--gray-brown; acidic   | $\frac{1}{2}$  |
| Glacial till--clay, sand; acidic   | $1\frac{1}{2}$ |
| Coal--No. 6, a soot streak, shaly  | $\frac{1}{2}$  |
| Shale <sup>1/</sup> --gray-brown, thin-bedded, silty; ferruginous          | 10             |
| Shale--blue-gray, hard, silty; acidic; with concre-<br>tions; carbonaceous | 12             |
| Coal--No. 5  | -              |

<sup>1/</sup> There is no massive, thick-bedded shale such as found in  
Section 20.



NO. 5, LOWER KITTANNING, COAL

STARK COUNTY

Section 20, Osnaburg Township

| Description of strata<br>(Top to bottom)                                     | Thickness            | Acidity              | Available    | Available   |
|--|----------------------|----------------------|--------------|-------------|
|  | : of :<br>: strata : | : of :<br>: strata : | :phosphorus: | :potassium: |
|  | <u>Feet</u>          | <u>pH</u>            |              |             |
| Soil--dark brown, forest cover sandy loam; acidic; rich in humus             | $\frac{1}{2}$        | 6.0                  | Low          | Low         |
| Glacial till--in places a sand, then a clay, yellow to brown; acidic         | 5                    | 5.0                  | Low          | Low         |
| Shale--upper foot with sandstone, remainder silty, gray; acidic; ferruginous | 10                   | 5.0                  | Low          | Low         |
| Coal--No. 6, a soot streak, not minable                                      | 2                    | 5.8                  | Low          | Low         |
| Clay--gray to yellow; ferruginous; sticky                                    | -                    | 4.5                  | Medium       | Low         |
| Coal--No. 5a, shaly, hard; ferruginous                                       | 1/12                 | 4.3                  | Medium       | Low         |
| Shale--gray, thick-bedded, very hard; ferruginous; acidic                    | 16                   | 5.1                  | High         | Low         |
| Shale--clayey, gray (Hamden) with nodular limestone                          | $\frac{1}{2}$        | 5.0                  | Medium       | Low         |
| Clay--dark gray; carbonaceous  | $\frac{1}{2}$        | 3.0                  | Low          | Medium      |
| Coal--No. 5  | -                    | -                    | -            | -           |

NO. 5, LOWER KITTANNING, COAL

STARK COUNTY

Section 1, Pike Township

| Description of strata<br>(Top to bottom)   | : Thickness :        | Acidity :            | Available :    | Available :   |
|--|----------------------|----------------------|----------------|---------------|
|  | : of :<br>: strata : | : of :<br>: strata : | : phosphorus : | : potassium : |
|  | <u>Feet</u>          | <u>pH</u>            |                |               |
| Soil--gray loam; acidic  | 1                    | 4.9                  | Low            | Low           |
| Shale--gray, thin-bedded,<br>silty, hard; ferrugi-<br>nous; carbonaceous;<br>acidic        | 12                   | 4.0                  | High           | Low           |
| Shale--blue-black; carbon-<br>aceous; slaty, fossiliferous,<br>silty                       | 6                    | 6.2                  | High           | Low           |
| Shale--gray-black (Hamden)<br>silty; acidic; fossil-<br>iferous, with nodular<br>limestone | 1                    | 4.1                  | High           | Low           |
| Shale--blue-black; carbon-<br>aceous; clayey; acidic                                       | 1+                   | 5.2                  | High           | Low           |
| Talus  | 3                    | -                    | -              | -             |
| Coal--No. 5  | -                    | -                    | -              | -             |

NO. 5, LOWER KITTANNING, COAL

STARK COUNTY

Section 7, Pike Township

| Description of strata<br>(Top to bottom)  | Thickness<br>(Feet) |
|---|---------------------|
| Soil--gray silt loam; acidic  | $\frac{1}{2}$       |
| Clay--gray, plastic; acidic   | 1                   |
| Sandstone--fragmental, mixed with sand and clay   | 1                   |
| Sandy clay--brown to yellow; acidic; lower $\frac{4}{5}$ a stiff plastic yellow clay, with iron concretions | 4                   |
| Shale--thin-bedded, silty; ferruginous; platy, soft   | 2                   |
| Coal--No. 5a  | 1                   |
| Shale--gray; ferruginous; thin-bedded with iron (orange) concretions and limestone nodules                  | 6                   |
| Shale--Hamden, gray-black, thin-bedded; fossiliferous; silty to clayey, with nodular limestone              | 1                   |
| Shale--gray-black, carbonaceous, clayey, soft; acidic   | 1                   |
| Coal--No. 5   | -                   |



NO. 5, LOWER KITTANNING, COAL

STARK COUNTY

Section 4, Sandy Township

| Description of strata<br>(Top to bottom)   | Thickness<br>(Feet) |
|--|---------------------|
| Soil--gray, silt loam  | $\frac{1}{2}$       |
| Clay--gray, plastic  | 6                   |
| Coal--No. 5a, a soot streak  | 1                   |
| Clay--gray to yellow   | 4                   |
| Shale--thick-bedded; ferruginous; hard; acidic;<br>with calcareous concretions <sup>1/</sup> | 30                  |
| Shale--clay (Hamden) partly calcareous <sup>2/</sup>   |                     |
| Coal--No. 5  |                     |

<sup>1/</sup> No concretions found which were not calcareous.

<sup>2/</sup> Shale just above coal not very acidic.

NO. 5, LOWER KITTANNING, COAL

STARK COUNTY

Section 17, Sandy Township

| Description of strata<br>(Top to bottom)  | :Thickness:<br>: of :<br>: strata : | Acidity:<br>: of :<br>: strata: | Available :<br>:phosphorus: | Available :<br>:potassium: |
|---|-------------------------------------|---------------------------------|-----------------------------|----------------------------|
|   | <u>Feet</u>                         | <u>pH</u>                       |                             |                            |
| Soil--brown sandy loam;<br>acidic   | $\frac{1}{2}$                       | 4.7                             | Medium                      | Low                        |
| Subsoil--yellow-brown<br>sandy clay; acidic   | 3                                   | 5.2                             | Low                         | Low                        |
| Sandstone--fragmental and<br>massive; acidic; gray to<br>brown  | 8                                   | 5.2                             | Low                         | Low                        |
| Shale--gray, silty, hard;<br>somewhat ferruginous;<br>acidic  | 16                                  | 3.9                             | High                        | Low                        |
| Shale--blue-gray, silty;<br>slightly carbonaceous;<br>fossiliferous, mixed with<br>calcareous nodules | 6+                                  | 6.2                             | High                        | Low                        |
| Talus   | 2                                   | -                               | -                           | -                          |
| Coal--No. 5   | -                                   | -                               | -                           | -                          |

NO. 5, LOWER KITTANNING, COAL

STARK COUNTY

Section 5, Sandy Township

| Description of strata<br>(Top to bottom)   | Thickness<br>(Feet) |
|--|---------------------|
| Soil--gray-brown silt loam; acidic   | $\frac{1}{2}$       |
| Clay--yellow, plastic; acidic  | 2                   |
| Sandstone--thin-bedded, gray; acidic; ferruginous  | 2                   |
| Shale--gray; transitional from sandy to silty;<br>hard; acidic   | 10                  |
| Shale--gray, silty; acidic, but with calcareous<br>nodular limestone in scattered spots                          | 6                   |
| Shale--gray-black; carbonaceous; fossiliferous,<br>calcareous, clayey  | $1\frac{1}{2}$      |
| Shale--hard, flaky, clayey; calcareous (Note:<br>This stratum <u>highly acid</u> in Sec. 23, Canton<br>Township) | 1                   |
| Coal--No. 5  | --                  |

Section 19, Tuscarawas Township

|   |               |
|---|---------------|
| Soil--gray silty clay loam; acidic  | $\frac{1}{2}$ |
| Glacial till--yellow and brown mottled clay; mixed<br>iron concretions, shale, granite                                    | 4             |
| Shale--gray to black, clayey, soft or flaky;<br>acidic  | 6             |
| Coal--No. 5a, poor quality  | 1             |
| Clay--gray, heavy, plastic; highly acidic   | 8             |
| Shale--clayey, thin-bedded, but mixed with it is<br>some red, ferruginous shale and ores, some of which<br>are calcareous | 2+            |
| Talus   | 8             |
| Coal--No. 5   | --            |



NO. 6, MIDDLE KITTANNING, COAL

CARROLL COUNTY

Section 30, Rose Township

| Description of strata<br>(Top to bottom)  | Thickness<br>(Feet) |
|---|---------------------|
| Soil--gray sandy loam; acidic   | $\frac{1}{2}$       |
| Subsoil--mixture of sand and fragmental sandstone   | 10                  |
| Sandstone--gray, massive, ferruginous; acidic   | 16                  |
| Shale--silty, gray, carbonaceous, ferruginous; acidic, but mixed with calcareous concretions; thin-bedded, soft | 16                  |
| Coal--No. 6   | -                   |

Section 33, Rose Township

| Description of strata<br>(Top to bottom)                                     | Thickness<br>of<br>strata | Acidity<br>of<br>strata | Available<br>phosphorus | Available<br>potassium |
|--|---------------------------|-------------------------|-------------------------|------------------------|
|  | <u>Feet</u>               | <u>pH</u>               |                         |                        |
| Soil--dark brown loam  | $\frac{1}{2}$             | 5.3                     | Medium                  | Low                    |
| Subsoil--light brown silt loam   | 1                         | 5.3                     | Low                     | Low                    |
| Shale--silty, mixed with sandy shale easily broken down to sand with fingers | 6                         | 6.4                     | Low                     | Low                    |
| Shale--thin-bedded, silty, with small amount of sandstone                    | 19                        | 6.8                     | High                    | Low                    |
| Coal--No. 6  | -                         | -                       | -                       | -                      |

NO. 6, MIDDLE KITTANNING, COAL

COSHOCTON COUNTY

Adams Township

| Description of strata<br>(Top to bottom)  | Thickness<br>(Feet) |
|---|---------------------|
| Soil--brown sandy loam, sometimes clayey  | $\frac{1}{2}$       |
| Subsoil--light brown sandy loam   | $1\frac{1}{2}$      |
| Sand and/or sandstone--dark red, orange, creamy;<br>sometimes 1 foot band of conglomerated material | 3 - 12              |
| Shale--yellowish-gray, slickensided, soft and<br>hard, silty or clayey                              | 0 - 4               |
| Shale--silty, dark gray to black; soft and<br>fissile on top, hard and bony on bottom               | 4 - 8               |
| Coal--No. 6   | -                   |

Section 7, Bedford Township

|  |       |
|--|-------|
| Soil--sandy loam   | 1     |
| Subsoil--clay and sand with thin layer of<br>broken thin sandstone and ferrous nodules | 4     |
| Shale--clay, soft, shades of gray and tan;<br>occasional sandy layers                  | 6 - 8 |
| Shale--dark gray, silty, sometimes olive gray  | 12    |
| Clay--gray; very acid; black next to coal  | 1     |
| Coal--No. 6  | 3     |

Jackson Township

|   |        |
|---|--------|
| Soil--not examined  | -      |
| Subsoil--not examined   | -      |
| Shale--clay or silty, light tan, thin-bedded  | 4      |
| Shale--silty or clay, mostly gray mottled yellow<br>and orange in spots; mostly hard, black and fissile<br>on bottom foot | 6 - 12 |
| Coal--No. 6   | 3      |

NO. 6, MIDDLE KITTANNING, COAL

STARK COUNTY

Section 31, Canton Township

| Description of strata<br>(Top to bottom)  | Thickness<br>(Feet) |
|---|---------------------|
| Soil--brown sandy loam; acidic  | $\frac{1}{2}$       |
| Subsoil--gray silty clay loam   | 3                   |
| Shale--thin-bedded, gray, silty; acidic; with some concretions; upper foot with fragmental sandstone, and lower $1\frac{1}{2}$ slightly carbonaceous                        | 16                  |
| Shale--black, clayey, soft, carbonaceous; very calcareous, with some nodular limestone. Also some spots of clay highly acid adjacent to calcareous spots. Not fossiliferous | $2\frac{1}{2}$      |
| Coal--No. 6 (?)   | -                   |

Section 36, Canton Township

| Description of strata<br>(Top to bottom)  | Thickness:<br>of<br>strata | Acidity:<br>of<br>strata | Available<br>phosphorus | Available<br>potassium |
|---|----------------------------|--------------------------|-------------------------|------------------------|
|   | <u>Feet</u>                | <u>pH</u>                |                         |                        |
| Soil--dark brown loamy sand; acidic   | $\frac{1}{2}$              | 4.3                      | Low                     | Low                    |
| Subsoil--brown sand, mixed with considerable sandstone rocks  | 3                          | 5.4                      | Low                     | Low                    |
| Sandstone--gray-brown; massive; acidic; becoming fragmental in spots where high-wall is not too high            | 6                          | 5.2                      | High                    | Low                    |
| Shale--thin-bedded and thick-bedded, gray, silty, hard; acidic  | 12                         | 5.6                      | High                    | Low                    |
| Shale--blue-gray to black, silty, hard; ferruginous; red mottling with concretions some of which are calcareous | 6+                         | 6.5                      | Medium                  | Low                    |
| Talus   | 10                         | -                        | -                       | -                      |
| Coal--No. 6   | -                          | -                        | -                       | -                      |



NO. 6, MIDDLE KITTANNING, COAL

STARK COUNTY

Section 7, Osnaburg Township

| Description of strata<br>(Top to bottom)  | Thickness:                   | Acidity:                     | Available    | Available   |
|---|------------------------------|------------------------------|--------------|-------------|
|   | : of :<br>: strata : strata: | : of :<br>: strata : strata: | :phosphorus: | :potassium: |
|   | <u>Feet</u>                  | <u>pH</u>                    |              |             |
| Soil--dark gray-brown sandy loam; acidic  | 1                            | 5.4                          | Low          | Low         |
| Glacial till--sand and clay, mixed with small igneous pebbles; acidic             | 4                            | 5.2                          | Low          | Low         |
| Shale--gray, silty, thin-bedded; acidic; with geodes and concretions; ferruginous | 10                           | 5.3                          | Low          | Low         |
| Shale--blue-gray to black, clayey; ferruginous; mixed with calcareous concretions | 6+                           | 4.3                          | High         | Low         |
| Talus   | 4                            | -                            | -            | -           |
| Coal--No. 6   | -                            | -                            | -            | -           |

Section 28, Osnaburg Township

|   |    |     |        |     |
|---|----|-----|--------|-----|
| Soil--gray silt loam; acidic  | 1  | 5.1 | Low    | Low |
| Subsoil--mostly silty, thin-bedded shale, with some soil; acidic  | 3  | 5.1 | Low    | Low |
| Shale--silty, hard, thin-bedded; acidic; with some geodes and iron concretions; gray-brown                | 18 | 4.6 | Low    | Low |
| Shale--gray, argillaceous, hard, flaky; acidic; thin-bedded and thick-bedded; ferruginous                 | 12 | 5.9 | Medium | Low |
| Shale--blue-gray to black, hard, thin-bedded, mixed with many concretions, all acidic; shale almost slaty | 12 | 6.5 | Medium | Low |
| Clay--dark gray, plastic; very acidic, mixed with acidic concretions                                      | 1  | 2.6 | Medium | Low |
| Coal--No. 6   | -  | -   | -      | -   |

NO. 6, MIDDLE KITTANNING, COAL

STARK COUNTY

Section 30, Osnaburg Township

| Description of strata<br>(Top to bottom)                                      | Thickness            | Acidity              | Available  | Available |
|---|----------------------|----------------------|------------|-----------|
|   | : of :<br>: strata : | : of :<br>: strata : | phosphorus | potassium |
|   | <u>Feet</u>          | <u>pH</u>            |            |           |
| Soil--gray-brown loamy sand;<br>acidic  | $\frac{1}{2}$        | 4.6                  | Medium     | Low       |
| Subsoil--red brown sand;<br>acidic  | 1                    | 5.1                  | Low        | Low       |
| Sandstone--fragmental, mixed<br>with much sand; reddish-<br>brown; acidic     | 8                    | 3.1                  | High       | Low       |
| Shale--gray, thin-bedded,<br>silty, hard; acidic                              | 12                   | 4.5                  | Medium     | Low       |
| Shale--blue-gray, flaky,<br>silty; acidic with some<br>calcareous concretions | 4+                   | 5.3                  | Low        | Low       |
| Talus   | 3                    | -                    | -          | -         |
| Coal--No. 6   | -                    | -                    | -          | -         |

Section 8, Paris Township

|   |               |     |        |     |
|---|---------------|-----|--------|-----|
| Soil--gray loam; acidic   | $\frac{1}{2}$ | -   | -      | -   |
| Glacial till--brown sandy<br>loam; acidic, with only small<br>amount of rock  | 3             | 5.9 | Medium | Low |
| Shale--gray, thin-bedded,<br>sandy; mixed with fragments<br>of sandstone; loamy and<br>somewhat silty   | 22            | 6.4 | High   | Low |
| Shale--gray, silty, thin-<br>bedded, with iron concretions;<br>lower 3 feet more slaty, car-<br>bonaceous, soft, with cal-<br>careous concretions | 14            | 6.2 | Medium | Low |
| Coal--No. 6   | -             | -   | -      | -   |

NO. 6, MIDDLE KITTANNING, COAL

STARK COUNTY

Section 28, Pike Township

| Description of strata<br>(Top to bottom)  | Thickness            | Acidity              | Available      | Available     |
|---|----------------------|----------------------|----------------|---------------|
|   | : of :<br>: strata : | : of :<br>: strata : | : phosphorus : | : potassium : |
|   | <u>Feet</u>          | <u>pH</u>            |                |               |
| Soil--brown silty clay loam   | $\frac{1}{2}$        | 4.7                  | Medium         | Low           |
| Subsoil--yellow-gray clay;<br>acidic  | 3                    | 5.3                  | Medium         | Low           |
| Sandstone--brown, fragmental;<br>mixed with some sand and clay<br>from stratum above it                                       | -                    | 4.3                  | Low            | Low           |
| Shale--brown to gray, texture<br>of fine sand or coarse silt;<br>rather thick-bedded but not<br>massive, with few concretions | 25                   | 5.3                  | Medium         | Low           |
| Shale--blue-gray, hard,<br>silty; fossiliferous   | 8+                   | 5.5                  | Low            | Low           |
| Talus   | 6                    | -                    | -              | -             |
| Coal--No. 6   | -                    | -                    | -              | -             |



NO. 6, MIDDLE KITTANNING, COAL

TUSCARAWAS COUNTY

Section 2, Sandy Township

| Description of strata<br>(Top to bottom)  | Thickness<br>(Feet) |
|---|---------------------|
| Soil--dark brown sandy loam   | 1                   |
| Subsoil--light brown sandy loam   | 2                   |
| Shale grading to thin-bedded sandstone--tan to light buff with ferrous colorations, sandy | 10 - 20             |
| Sandstone--brown, weathers light  | 1 - 3               |
| Shale--black, soft, silty; carboniferous  | 2 - 4               |
| Coal--No. 6   | 2 - 3               |

Section 11, Sandy Township

|   |           |
|---|-----------|
| Soil--brown sandy loam  | 1         |
| Subsoil--light brown, sandy with pieces of sandstone  | 3         |
| Sand and/or sandstone--loose sugary sand grading through thin-bedded sandstone to massive sandstone | 10 - 25   |
| Shale--gray to grayish-black, thin-bedded, nodular, silty   | 4 - 12    |
| Coal--No. 6   | 3 approx. |

NO. 7, UPPER FREEPORT, COAL

STARK COUNTY

Section 10, Osnaburg Township

| Description of strata<br>(Top to bottom)  | :Thickness:<br>: of :<br>: strata : | Acidity:<br>: of :<br>: strata : | Available :<br>:phosphorus: | Available :<br>:potassium: |
|---|-------------------------------------|----------------------------------|-----------------------------|----------------------------|
|   | <u>Feet</u>                         | <u>pH</u>                        |                             |                            |
| Soil--gray-brown loamy sand;<br>acidic  | $\frac{1}{2}$                       | 4.7                              | Low                         | Low                        |
| Glacial till--red-brown<br>sand, mixed with sandstone<br>fragments and igneous rocks;<br>acidic   | 3                                   | 4.7                              | Medium                      | Low                        |
| Sandstone--upper 3 feet thin-<br>bedded, ferruginous, frag-<br>mental, remainder massive<br>but so soft (except lower<br>2 feet) that it crumbles<br>in hand; acidic; lower 3<br>feet hard, ferruginous | 24                                  | 4.0                              | High                        | Low                        |
| Shale--gray, thin-bedded,<br>silty, soft; very acid   | 12                                  | 4.2                              | High                        | Low                        |
| Shale--silty, carbonaceous,<br>gray-black; thin-bedded,<br>with many acidic concretions   | 10                                  | 4.9                              | Medium                      | Low                        |
| Shale--gray, carbonaceous,<br>bony, hard; acidic  | $\frac{1}{2}+$                      | 5.8                              | Medium                      | Low                        |
| Talus   | 2                                   | -                                | -                           | -                          |
| Coal--No. 7   | -                                   | -                                | -                           | -                          |

NO. 7, UPPER FREEPORT, COAL

STARK COUNTY

Section 1, Paris Township

| Description of strata<br>(Top to bottom)  | :Thickness:<br>: of :<br>: strata : | Acidity:<br>: of :<br>: strata : | Available<br>phosphorus | Available<br>potassium |
|---|-------------------------------------|----------------------------------|-------------------------|------------------------|
|   | <u>Feet</u>                         | <u>pH</u>                        |                         |                        |
| Soil--gray loam; acidic   | 1                                   | 5.1                              | Low                     | Low                    |
| Glacial till--a mixture<br>of sand, clay, sandstone,<br>concretions, shale, lime-<br>stone and igneous rock;<br>mostly calcareous | 12                                  | 6.4                              | High                    | Low                    |
| Shale--gray, thin-bedded,<br>sandy, mixed with thin-<br>bedded, ferruginous sand-<br>stone; mostly acidic                         | 16                                  | 7.3                              | Low                     | Low                    |
| Shale--gray, silty; acidic;<br>hard, mixed with iron con-<br>cretions   | 4                                   | 5.7                              | High                    | Low                    |
| Coal--No. 7   | -                                   | -                                | -                       | -                      |



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